

WE CLAIM:

1 1. A tunable optical filter for transmitting light in a
2 first band of wavelengths centered about a bandpass wavelength
3 that is tunable over a second wider band, comprising:
4 first and second reflectors held in substantially
5 parallel alignment and separated by a variable air gap;
6 a partitioned cavity including a first dielectric layer
7 on the first reflector, the variable air gap and a second
8 dielectric layer on the second reflector, said partitioned
9 cavity having an effective optical thickness substantially
10 equal to an integral multiple of one half the bandpass
11 wavelength and having an effective refractive index greater
12 than one, said first and second dielectric layers each having
13 an optical thickness less than one fourth of the shortest
14 wavelength within the second wider band; and
15 a tuning mechanism for moving at least one of said
16 reflectors to vary the air gap and tune the bandpass
17 wavelength.

1 2. The tunable optical filter of Claim 1, wherein said first
2 and second reflectors each comprise a quarter-wave stack
3 including a plurality of layers of alternating high and low
4 refractive index each having an optical thickness equal to one
5 fourth of a reference wavelength within the second wider band.

1 3. The tunable optical filter of Claim 2, wherein said first
2 and second dielectric layers each comprise the same material
3 as the high refractive index layer in the quarter-wave stack.

1 4. The tunable optical filter of Claim 1, wherein said first
2 and second reflectors each comprise a metal film.

1 5. The tunable optical filter of Claim 1, wherein said first
2 and second reflectors each comprise a gradient index rugate
3 reflector having continuously modulated refractive index.

1 6. The tunable optical filter of Claim 1, wherein said first
2 and second dielectric layers are of equal optical thickness.

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1 7. The tunable optical filter of Claim 6, wherein said first
2 and second dielectric layers each comprise a single material
3 having a constant refractive index throughout its thickness.

1 8. The tunable optical filter of Claim 1, wherein said first
2 and second dielectric layers each comprise a gradient index
3 layer having a refractive index that varies monotonically from
4 a low value proximate the air gap to a high value proximate
5 the reflector.

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1 9. The tunable optical filter of Claim 8, wherein said
2 filter also transmits light at wavelengths in a fixed band of
3 wavelengths outside of the second wider band.

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1 10. The tunable optical filter of Claim 1, wherein said
2 partitioned cavity has an effective optical thickness equal to
3 one half the bandpass wavelength.

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1 11. The tunable optical filter of Claim 1, wherein the
2 variable air gap has an optical thickness less than one half
3 the bandpass wavelength, said partitioned cavity having an
4 effective refractive index greater than one.

1 12. The tunable optical filter of Claim 1, wherein the tuning
2 mechanism comprises one of a piezoelectric, electrostatic or
3 electromagnetic actuator.

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1 13. A tunable optical filter, comprising:

2 first and second reflectors held in substantially
3 parallel alignment and separated by a variable air gap to
4 transmit light in a first band of wavelengths centered about a
5 bandpass wavelength that is tunable over a second wider band;
6 a first dielectric layer on the first reflector, and
7 a second dielectric layer on the second reflector, said
8 first and second dielectric layers each having an optical
9 thickness less than one fourth wavelength the shortest
10 wavelength within the second wider range.

1 14. The tunable optical filter of Claim 13, wherein said
2 first and second reflectors each comprise one of (a) a
3 quarter-wave stack including a plurality of layers of
4 alternating high and low refractive index or (b) a gradient
5 index rugate reflector having continuously modulated
6 refractive index.

1 15. The tunable optical filter of Claim 14, wherein said
2 first and second dielectric layers each comprise a single
3 material having a constant refractive index throughout its
4 thickness.

1 16. The tunable optical filter of Claim 15, wherein said
2 first and second dielectric layers each comprise the same
3 material as the high refractive index layer in the quarter-
4 wave stack.

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1 17. The tunable optical filter of Claim 14, wherein said
2 first and second dielectric layers each comprise a gradient
3 index layer having a refractive index that varies
4 monotonically from a low value proximate the air gap to a high
5 value proximate the reflector.

1 18. The tunable optical filter of Claim 17, wherein said
2 filter also transmits light at wavelengths in a fixed band of
3 wavelengths outside of the second wider band.

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1 19. The tunable optical filter of Claim 13, wherein said
2 partitioned cavity has an effective optical thickness equal to
3 one half the bandpass wavelength and the variable air gap has
4 an optical thickness less than one half the bandpass
5 wavelength to define a lowest order filter, said partitioned
6 cavity having an effective refractive index greater than one.

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1 20. A tunable optical filter for transmitting light in a
2 first band of wavelengths centered about a bandpass wavelength
3 that is tunable over a second wider band, comprising:
4 an optical substrate;
5 a first reflector on said optical substrate;
6 a first dielectric layer on a top surface of said first
7 reflector;
8 a second reflector;
9 a second dielectric layer on a bottom surface of said
10 second reflector; and
11 a tuning mechanism on the optical substrate that holds
12 said second reflector in substantially parallel alignment with
13 said first reflector and separated by an air gap to form a
14 lowest order filter, said air gap being variable to tune the
15 first band over the second wider band, said first and second
16 dielectric layers each having an optical thickness less than
17 one fourth wavelength of the shortest wavelength within the
18 second wider band.

1 21. The tunable optical filter of Claim 20, wherein said
2 first dielectric layer, the variable air gap and the second
3 dielectric layer define a partitioned cavity having an
4 effective optical thickness substantially equal to one half
5 the bandpass wavelength and having an effective refractive
6 index greater than one.

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1 22. The tunable optical filter of Claim 21, wherein said
2 first and second reflectors each comprise one of (a) a
3 quarter-wave stack including a plurality of layers of
4 alternating high and low refractive index or (b) a gradient
5 index rugate reflector having continuously modulated
6 refractive index.

1 23. The tunable optical filter of Claim 22, wherein said
2 first and second dielectric layers each comprise a single
3 material having a constant refractive index throughout its
4 thickness.

1 24. The tunable optical filter of Claim 23, wherein said
2 first and second dielectric layers each comprise the same
3 material as the high refractive index layer in the quarter-
4 wave stack.

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1 25. The tunable optical filter of Claim 22, wherein said
2 first and second dielectric layers each comprise a gradient
3 index layer having a refractive index that varies
4 monotonically from a low value proximate the air gap to a high
5 value proximate the reflector.

1 26. The tunable optical filter of Claim 25, wherein said
2 filter also transmits light at wavelengths in a fixed band of
3 wavelengths outside of the second wider band.